

Yale University

EliScholar – A Digital Platform for Scholarly Publishing at Yale

Cowles Foundation Discussion Papers

Cowles Foundation

9-1-2004

Locational Competition and the Environment: Should Countries Harmonize Their Environmental Policies?

William D. Nordhaus

Follow this and additional works at: <https://elischolar.library.yale.edu/cowles-discussion-paper-series>



Part of the [Economics Commons](#)

Recommended Citation

Nordhaus, William D., "Locational Competition and the Environment: Should Countries Harmonize Their Environmental Policies?" (2004). *Cowles Foundation Discussion Papers*. 1322.
<https://elischolar.library.yale.edu/cowles-discussion-paper-series/1322>

This Discussion Paper is brought to you for free and open access by the Cowles Foundation at EliScholar – A Digital Platform for Scholarly Publishing at Yale. It has been accepted for inclusion in Cowles Foundation Discussion Papers by an authorized administrator of EliScholar – A Digital Platform for Scholarly Publishing at Yale. For more information, please contact elischolar@yale.edu.

COWLES FOUNDATION FOR RESEARCH IN ECONOMICS
AT YALE UNIVERSITY

Box 2125, Yale Station
New Haven, Connecticut 06520

COWLES FOUNDATION DISCUSSION PAPER NO. 1079

Note: Cowles Foundation Discussion Papers are preliminary materials circulated to stimulate discussion and critical comment. Requests for single copies of a Paper will be filled by the Cowles Foundation within the limits of the supply. References in publications to Discussion Papers (other than mere acknowledgment by a writer that he has access to such unpublished material) should be cleared with the author to protect the tentative character of these papers.

LOCATIONAL COMPETITION AND THE ENVIRONMENT:
SHOULD COUNTRIES HARMONIZE THEIR ENVIRONMENTAL POLICIES?

William D. Nordhaus

September 1994

Locational Competition and the Environment: Should Countries Harmonize Their Environmental Policies?

William D. Nordhaus
Yale University
August 3, 1994 (1:54pm)

Abstract

In debates about economic unification or trade liberalization, it is often asked whether harmonization should go beyond taxes and macroeconomic policies to include regulations, particularly environmental policy. This issue also arises when countries, states, and cities engage in competition for plants, jobs, or exports in what we might call "locational competition." This essay analyzes locational competition with particular reference to environmental policy. The conclusions are the following: First, economic efficiency requires harmonization of policies for global environmental issues; second, for local public goods or externalities, there is a strong presumptive case against harmonization; and finally that a competitive "race to the bottom" in environmental policies is inconsistent with countries' following their own economic self-interests.

Locational Competition and the Environment: Should Countries Harmonize Their Environmental Policies?

**William D. Nordhaus¹
Yale University**

I. The Economics of Trade and the Environment

Until the 1990s, economists and environmentalists paid little attention to the connection between international trade and the environment. This has changed over the last decade, beginning with concerns over global environmental issues and then exploding after the GATT (General Agreement on Tariffs and Trade) 1991 tuna-dolphin decision. That decision by a GATT panel ruled that a U.S. embargo on tuna caught with "dolphin-unsafe" methods was an unfair trade barrier; the panel held that trade measures to protect the environment outside the jurisdiction of a country were not permissible under the GATT.²

At that point environmentalists woke up to the possibility that trade laws would interfere with domestic and international environmental policies. One reaction, displaying a typical lack of understatement, was that of "consumer advocate" Ralph Nader:

Citizens beware. An unprecedented corporate power grab is underway in global negotiations over free trade....The Fortune 200's GATT and NAFTA agenda would make the air you breathe dirtier and the water you drink more polluted. It would destroy family farms and undermine consumer protections such as those ensuring that the food you eat isn't compromised by unsanitary conditions or higher levels of pesticides and preservatives.³

¹The author benefited from discussions with Bruce Ackerman, Edith Brown-Weiss, Horst Siebert, T. N. Srinivasan, the discussant, and participants in the 1994 Kiel Conference. All errors are my responsibility. [C: \KIEL94 \TRAD0803 .MS3]

²See Zaelke, Orbuch, and Housman [1993].

³See Nader [1993], p. 1.

Friends of dolphins at that point became bitter enemies of free trade and its embodiment in the Uruguay Round of GATT and the North American Free Trade Agreement (NAFTA). In the debate over NAFTA, a number of environmental groups opposed the agreement on the grounds that it might lead to a deterioration of environmental quality either in the U.S. or in Mexico or both. The same issue is being raised in the European Union, where the question is raised as to whether harmonization should go beyond taxes and macroeconomic policies to include environmental policies. 28 environmental groups have called for the rejection of the Uruguay round of trade negotiations as harmful to the environment.⁴ And many groups are arguing that unless we harness our trade laws to the environmental objectives, we are heading for ruin, as for example:

The deliberate overutilization of natural resources is compromising global economic and ecological security by threatening biodiversity and depleting the world's capital reserves.⁵

And while economists may differ with environmentalist views of trade and GATT, one eminent defender of free trade, Jagdish Bhagwati, agrees about the importance of the issue, stating, "International trade and the environment are arguably the most important issues on the global economic agenda for the last decade of this millennium."⁶

This question can be put differently in terms of the grounds for *locational competition*. Countries, states, and cities often engage in competition for plants, jobs, or exports -- in what we might call "locational competition" -- through a variety of different instruments. Among the favorites are tax advantages, low-interest loans, provision of infrastructure, and zoning preferences. To what extent is it appropriate to allow different jurisdictions to use environmental policy as a tool of locational competition? Put differently, does the goal of economic efficiency lead to the conclusion that environmental standards should be harmonized in the way that tariffs and quotas are harmonized?

This entire discussion is at the same time strange and familiar. It is strange because the environmentalist attack on trade would seem to run counter to the major

⁴ See *Financial Times* [1992].

⁵ Housman and Zaelke [1992].

⁶ See Bhagwati [1993], p. 159. Also see Kaufmann et al. [1993]

tenets of international-trade theory as well as international law in that high-income countries are imposing their domestic standards and preferences on countries with either different preferences or lower abilities to pay for environmental protection. It is at the same time familiar in that non-economic grounds often intrude onto trade policy as covert ways of rationalizing protectionism.

The standard presumption in international trade is that domestic environmental questions are ones that are entirely within the purview of national economic policy. They are not only no one else's business, but the attempt to force a country to raise its environmental standards above (or below) the level it chooses for itself is inefficient and would make the country that changed its environmental standards worse off. In other words, harmonization of local environmental policies, like harmonization of wages, is a thoroughly bad idea.

The purpose of this paper is to examine this question in depth. We first review the standard analysis of environmental problems and their solutions in a closed economy framework. We then state the fundamental theorems of trade and the environment for both global and local public goods. In the final section, we review some of the reasons why the fundamental theorem might not hold in certain circumstances.

II. *Environmental Policy in a Closed Economy*

A. Sources of Environmental Problems

It will be useful to begin with standard environmental theory and its application in a closed economy.⁷ Economists tend to separate activities into those with *external effects* or *externalities* and activities without significant external effects. External effects occur when the costs (or benefits) of an activity spill over to other people, without those other people being paid (or paying) for the costs (or benefits) incurred (or received). Externalities generally arise when property rights are deficient, that is when the costs or benefits of an activity are not entirely appropriable or appropriated by an owner. When a firm uses a scarce appropriable resources like land, oil, or trees, the firm buys the good from its owner, who is fully

⁷ A useful survey is contained in Cropper and Oates [1992].

compensated for the incremental costs of production of the good. But many interactions take place outside market. When *A* dumps a toxic chemical into a stream and fouls the stream for people who fish or swim downstream, *A* has used the scarce, clean water without paying people whose water is fouled; it has generated an external diseconomy.

Examples of inappropriate resources are found in every corner of the globe. In the case of fisheries, a school of tuna not only provides food for the dinner table but also stock for breeding future generations of fish. Yet this breeding potential is not captured or appropriated by markets; no one buys or sells the mating behavior of yellow-fin tuna. Consequently, when a fishing boat pulls out a tuna, it does not compensate society for the depletion of future breeding potential. Therefore, when unregulated, fisheries tend to be overfished. Moreover, if tuna and dolphin tend to swim together, "dolphin unsafe" processes for catching tuna will also net dolphin, and unnecessary destruction of dolphins may cause pain to lovers of those gregarious creatures.

B. Global v. Local Externalities

In the analysis of trade and the environment, the key distinction is between local and global externalities. At one end of the spectrum are pure local external effects like noise or cigarette smoke, which seldom go beyond a few meters. At the other extreme are the global environmental problems such as greenhouse warming, ozone depletion, or species extinction. These are global not in the sense that the impacts are everywhere the same, but in that the social costs of an activity such as emitting carbon dioxide or chlorofluorocarbons are independent of where the emissions take place.

In between the polar cases are intermediate cases, such as acid rain or deforestation, which contain significant elements of local and global externalities, and in some cases there are genuine ambiguities as to whether a particular activity is local or global. Nonetheless, we must keep in mind this crucial distinction if we are to make sense of the economist's view of trade and the environment.

C. Optimal Policy

We discuss briefly here optimal policy for a closed economy in the face of external effects. This discussion will focus on harmful externalities (such as pollution) rather than beneficial ones (like AIDS vaccines) because that is the focus of the debate. For simplicity, I will refer to the harmful activity as pollution or emissions.

1. Homogeneous pollutants

Begin with the simple case of homogeneous pollution. This case is one where the marginal social costs of emissions are equal in all parts of the region. Because of the homogeneity, we can show the basic economics in Figure 1. We are interested in the optimal emissions reduction. The benefits of emissions reductions (r) are shown as the downward-sloping marginal benefit (MB) curve. The second relationship is the marginal cost of emissions reduction, which portrays the costs that the economy undertakes to reduce a unit of emissions. Figure 1 shows schematically the marginal cost of cost-effective emissions reductions as MC. From an economic point of view, efficient policies are ones in which the marginal costs are balanced with the marginal benefits of emissions reductions. We can determine either the optimal rate of emissions reduction (r^*) or the optimal emissions tax or fee (T^*). Figure 1 shows schematically how the efficient rate of emissions reduction and the optimal emissions tax are determined. Under conditions of certainty and homogeneity, efficiency can be attained by either an emissions fee or by standards. The pure market solution comes with emissions reductions at 0, where MB is far above the zero MC. Point E represents the efficient point at which marginal abatement costs equal marginal benefits.

2. Complications

Life is much more complicated than the simple picture in Figure 1 because of a wide variety of inhomogeneities, uncertainties, and administrative costs.

a. *Regional inhomogeneity*

Perhaps the most important complication is regional inhomogeneity. In most cases,

pollution has different impacts in different areas. For example, the health effects of sulfur emissions or radioactive iodine are quite different in the middle of New York or Kiev from in the ocean or 20,000 feet under the earth's surface. The relationship can be tracked as follows:

(1) { Emissions → concentrations → human and non-human exposures →
human and non-human impacts and adaptations → economic effects

Each of these steps is extremely complicated, involving complex and often poorly understood relationships from the natural, biological, and social sciences. What we need for an optimal policy is to calculate the economic effects using the schematic relationship in (1) for each of the different regions and then go through the analysis in Figure 1 to determine the optimal abatement or emissions tax.

In practice, this calculation is almost never done. The only near-complete example that I know was done for Connecticut by Robert Mendelsohn [1978] and is reproduced in Figure 2. This calculation for sulfur emissions shows clearly that the marginal benefits of abatement differ radically over space.

b. *Temporal inhomogeneity*

Often, damages are highly nonlinear over time as well as space, with damages and costs affected by the season, time of day, and weather. In principle, Figure 2 should have a temporal dimension as well as a spacial dimension, with time-of-day as well as place-of-origin pricing. For example, automotive emissions have a much more significant damage in Los Angeles during hot days with temperature inversions than during cool, dry, and windy days.

c. *Uncertainty*

Even after decades of study, there is great uncertainty about the economic impacts of many externalities. Does exposure to radioactivity follow a linear or non-linear dose-response curve? Is exposure to magnetic flux harmful? What is the threshold level of exposure to ozone? What will be the impacts of global warming

on poor countries? How many valuable species are being eradicated by tropical deforestation? These are just a few of the challenges for science in this area.

An important analysis of the implications of uncertainty by Weitzman [1975] shows that uncertainty may have implications for the relative advantage of quantitative standards v. emissions charges. Weitzman and subsequent analyses indicate that emissions charges are advantageous where the marginal benefit curve in Figure 1 is flat relative to the marginal cost curve, with the converse holding in the opposite case. When this analysis is applied to "stock externalities" such as global warming or ozone depletion, the implication is that emissions fees or taxes are much more efficient than quantitative standards or auctionable quotas.⁸

In the face of such vast uncertainties, societies have tended to respond to uncertainty in different ways. The economist's recommended approach to uncertainty is to calculate the *expected* costs and benefits and then apply the principles sketched in Figure 1. Often, poor countries just ignore environmental problems, partly out of ignorance and partly out of other pressing needs. In rich countries, one response is to follow the "precautionary principle," which is a maximin approach by which society takes steps assuming the worst possible outcome. In practice, uncertainty tends to blur out most of the regional, temporal, and other inhomogeneities and to lead decision makers to uniform standards and fees.

d. *Administrative costs*

A final complication is the presence of large costs of administration of environmental programs. A major cost is that of simply gathering information. The U.S. Environmental Protection Agency (EPA) is charged with a wide variety of responsibilities and has relatively limited staff and budget for external studies. Given its mandate, it can only make rudimentary estimates of the costs and benefits of different programs. For example, even though the EPA has been regulating sulfur

⁸ A "stock externality" arises where the impact or damage at issue is a function of the stocks or accumulations rather than of the flows of pollutants or other output. For example, in the case of global warming, the climatic impact of greenhouse gases is a function of the stock of greenhouse gases in the atmosphere rather than of the flow of emissions. Most global environmental problems are stock externalities.

emissions for a quarter-century, it is only now undertaking a complete study of the benefits of reducing sulfur emissions along the lines described in equation (1) above.⁹

Additional costs are monitoring and administering the programs. An efficient program would ideally incorporate regional and temporal differences in standards or prices, but this would require a level of monitoring and enforcement which the environmental agencies cannot perform and which most companies would strenuously resist. Indeed, very few companies engage in temporal pricing even though it would have a significant effect on their profits (the airlines are a major exception).

The upshot of these administrative costs is that environmental programs tend to be very simple, even crude, in their design. Agencies rely almost entirely on quantitative standards rather than emissions fees, and the standards tend to be uniform for large regions, such as states or countries, for each technology. The standards are very infrequently changed, perhaps once a decade at most. The only examples of price-type or emissions-fee approaches in the United States are the tax on ozone-depleting chemicals and the nascent emissions-trading program for sulfur-dioxide emissions. The latter has proven very complicated to establish and ironically is even cruder than the standards program because it is a uniform national program with no differentiation of price for different regions. A look at Figure 2 suggests how inefficient a uniform national pricing system would be relative to the optimal program, yet many analysts believe that the new system is a major improvement over the older standards system.

e. *Implications*

What are the implications of this litany of difficulties in setting efficient environmental problems? The major implication is to emphasize that the actual policies are likely to be far from efficient given the difficulties of determining the optimal ones. Efficient policies are highly specific to particular sectors, regions, and time periods. Analysts should be moving to help setting policies differentially so as to reduce the harm from setting uniform policies over space, time, and sectors.

⁹ The complete study was mandated by Congress under the 1990 Clean Air Act Amendments.

III. Environmental Policy in the Open Economy

We now move to consider environmental policy in the open economy. The framework is one in which there are many countries. For simplicity, we assume that each country has complete internal mobility of capital and labor, has completely immobile and heterogeneous land, and produces a number of both traded and non-traded goods.¹⁰ The prices of tradable goods are assumed to be equalized across countries, while neither non-traded goods nor factor prices are equalized.¹¹

The issue raised here is whether environmental policies should be "harmonized." Harmonization denotes setting equivalent standards, regulations, or taxes in different jurisdictions. These may refer to product standards, which apply to the characteristics of a good or service, or process standards, which apply to the production process for a good or service.¹²

Each country is assumed to set its environmental policies in the first-best framework sketched in Figure 1. In the analysis that follows, we consider a purely global environmental problem and a purely local environmental problem.

A. Global environmental problems

The case of global environmental issues is straightforward. For these, the marginal benefits of emissions reductions are everywhere equal, while the marginal costs may differ by region, sector, and time period. The basic analysis for global stock externalities is shown in Figure 3. We show the MB-L schedule as downward sloping to indicate the effect of different long-run or *steady-state* emissions

¹⁰ "Non-traded goods" are usually defined as ones for which the transportation costs are greater than the cost spread between regions (e. g., haircuts). Most environmental quality indexes are inherently local and non-traded, such as the air quality in the middle of Paris or the visibility at the Grand Canyon.

¹¹ A systematic analysis of the incorporation of public goods in international trade is presented in Bhagwati and Srinivasan [1993].

¹² For a discussion of harmonization, see Jackson [1992] and Charnovitz [1993].

reductions, while the heavy horizontal line marked MB-S represents the short-run marginal benefit curve. Here, at a given time, the marginal benefit of emissions reductions is approximately constant because the flow of emissions in a given period does not appreciably affect the stock. We show two different countries, 1 and 2, with differing marginal cost curves. The MC curve for country 1 is further to the right indicating that any level of emissions reductions is less expensive there than in country 2.

The efficient environmental policy would be for country 1 to operate at point E1 with country 2 at E2. Abatement should be pursued up to the point where the marginal cost *in each region* equals the marginal benefit. Both would use or face the same emissions fee, T^* , but the rate of emissions reduction is greater in 1 than two because of cost considerations ($r_1 > r_2$). This leads to the basic result for global externalities:

Result 1. The major conclusion here is that *for global environmental problems, efficiency requires that countries harmonize their environmental policies*. The harmonization comes through equating the marginal cost of emissions reductions and not through common standards such as equalizing the percentage reductions of the global pollutant.

This fundamental conclusion provides an interesting comment on the strategies agreed upon for coordinating climate-change policies at the 1992 Rio Earth Summit. Countries agreed that each would attempt to stabilize its emissions at 1990 levels.¹³ While this policy has the advantage of simplicity, it would be inappropriate except in the unrealistic case where the level and growth in cost functions were identical.

¹³ The Earth Summit in Rio in June 1992, formally known as UNCED, or the United Nations Conference on Environment and Development, agreed upon framework treaties on climate and on biological diversity and established a number of working groups to monitor compliance and propose next steps.

B. Local environmental problems

1. Local pollution as a non-traded good or factor

Turn next to the other polar case of local pollution. For this case, we can think of environmental questions such as most air and ground-water pollution, noise, toxic wastes, worker health and safety problems, soil erosion, and so forth. While some of these have transboundary effects, particularly for small countries, we will consider only the local (i. e. within-country) effects. For this section, we assume that the externality is homogeneous *within* a country but heterogeneous *across* countries.

Putting these in the context of standard international trade theory, local public goods or externalities are *non-traded goods or factors*. By this, we mean that they are fundamentally locational, like land, that they do not trade in international markets, and that prices will generally differ across country boundaries. Local environmental conditions may be viewed either as factors of production (as in the case of sulfur-dioxide emissions) or as consumer goods or services (as in the case of potable water or visibility). Whether goods or factors, it is absolutely fundamental for the view of trade and the environment sketched here to see that local environmental quality is a non-traded commodity; we do not and should not observe price equalization of local environmental factors or final environmental goods and services.¹⁴

2. The fundamental result

Once we recognize that local externalities are non-traded goods or factors, we can go to standard international trade theory to determine the efficient policies. In order to apply the standard theory, we need to assume (1) that environmental goods are correctly priced *internally* and (2) that the conventional assumptions of classical

¹⁴ This can be confusing because the good or service that is *produced* by the non-traded environmental good or service may well be involved in international trade. However, we must distinguish the non-traded environmental input (air in the Ruhr) from the traded good for which the non-traded environmental input is used (steel produced and shipped from the Ruhr).

trade theory hold. Under these conditions, the *internalized competitive equilibrium*¹⁵ is Pareto efficient in the sense that no country, and no group or individual within a country, can be made off without making another country, group, or individual worse off. This leads immediately to the central result for local environmental goods:

Result 2. *For local environmental problems, under competitive conditions, efficiency requires that countries should not harmonize their environmental policies.* Countries should determine their policies by balancing local marginal costs and marginal benefits. The resulting efficient standards or emissions fees will generally be different in different countries just as is the case for other non-traded factors like land and labor or goods like haircuts and meals. *Efforts to harmonize policies for local environmental problems will lead to a decline in potential economic welfare.*

The basic analysis is depicted in Figure 4, which shows the efficient outcome for two countries. Country 1 might be a low-income country, with relatively high costs of abatement and relatively low damages from pollution. Its best policy would come at E1, with a lower efficient reduction rate and a lower efficient pollution tax. High-income country 2 would land at point E2, with more stringent requirements. Simply put, countries may *efficiently* decide on different environmental standards because of differences in preferences and/or technologies.

Putting these results in the language of international trade, we should treat global externalities as traded goods, which will exhibit price equalization in different regions. Local externalities will generally not display price equalization (either as final goods or as inputs), although through international trade of the final goods we would expect some equalization of prices of non-traded factors.

One of the most egregious violations of Result 2 is the ban on exports of

¹⁵ The standard assumptions of trade theory would be perfectly competitive markets in all goods and factors, no uninternalized externalities, complete markets, no distortionary government tax or transfer programs, and no trade barriers. For simplicity, I call this an *internalized competitive economy*.

hazardous wastes countries.¹⁶ Suppose that high-income and densely populated country *A* experiences extremely high costs of disposal of toxic wastes and proposes to ship them for disposal in low-income and sparsely populated country *B*. If each country knowingly agrees to the transaction, there is no obvious reason why it would not raise the incomes in both regions. A rule that each country or region should dispose of its wastes makes no more sense than a rule that each household should bury its own garbage in its own back yard.¹⁷ Lawrence Summers withstanding, there is comparative advantage in disposition of bads as well as production of goods.

3. Losses from inappropriate harmonization

We can illustrate the losses from inappropriate harmonization of local public goods in Figure 5. The circles in the diagram show the life expectancy at birth and the per capita purchasing-power-parity consumption of 65 countries ranging from high-income countries of the North, through middle-income countries, and to the poorest countries of Africa. The graph shows the clear association of life expectancy and income. In addition, we have shown illustrative production-possibility frontiers (*PPFs*) for groups of countries, where *L* shows the tradeoffs in low-income countries between consumption today and investments that prolong life expectancy, and *M* and *H* are the *PPFs* for middle- and high-income countries. By investing in health and medical services, countries can extend their population's life expectancy. We show the choices that representative countries make as *L**, *M**, and *H**.

Note that high-income countries have less favorable returns on health investments, as shown by the relative slopes of the *PPFs* at the chosen points. The

¹⁶ The Basel Convention on the Transboundary Movement of Hazardous Wastes and Their Disposal requires prior informed consent from recipient countries and obliges exporting countries to deny movement if they have reason to believe that the wastes will not be handled in an "environmentally sound manner."

¹⁷ See the infamous leaked memorandum *Economist* [1992] in which Summers is reported to have written: "Just between you and me [!], shouldn't the World Bank be encouraging more migration of dirty industries to the LDCs?... I think the economic logic behind dumping a load of toxic waste in the lowest-wage country is impeccable and we should face up to it." Alas, Swiftian wit does not mix well with environmental political correctness.

lower slope at H^* means that high-income countries must sacrifice a larger fraction of current consumption to extend life expectancy by a year than would must low-income countries. The line marked "2" coming out of the low-income point L shows the opportunities available in low-income countries through, say, immunization, primary-health clinics, training of paramedical staff, and education.¹⁸ The terms of trade between health and consumption shown by "2" are much more favorable than the slope marked "1." The latter represents the health gains in low-income countries from applying the technologies of the high-income countries (which are given by the *PPF's* slope at H^*).

From this diagram we can see why harmonization of environmental standards for local public goods is inefficient (just as harmonization of housing codes, appliance standards, or health protocols would be). In low-income countries, there are more efficient ways of raising the region's health status or environmental quality than adopting the environmental standards of the high-income countries. By forcing countries to adopt inappropriate technologies, the country is pushed inside its *PPF*, as in arrow "1", and the country would be made worse off rather than better off.

IV. *Other Rationales for Harmonization*

A. Introduction

Standard international-trade theory presents a very strong case against harmonization of environmental standards or effluent charges across regions or countries for local public goods or local externalities. Yet there is a very strong movement today, particularly among the environmental community, to push for high common international standards, to promote "green" or environmentally sound products, to impede the free flow of toxic wastes among consenting governments, to use trade sanctions on countries that do not conform to high environmental standards, and to impose the standards of the more stringent partners in free-trade agreements.¹⁹ In short, there is a strong *urge to harmonize upward standards for local public goods*.

¹⁸ See World Bank [1993].

¹⁹ Some of the issues involved in using trade sanctions to enforce global environmental agreements are discussed in Whalley [1991].

At the same time, there is also an urge to harmonize environmental policies by many advocates of free trade. The idea here is that differential environmental policies may be hidden forms of protectionism, as when a country puts tougher standards on those products which just happen to be imported. By requiring harmonization, in effect countries would remove a potential non-tariff barrier. Indeed, the Uruguay round contains some provisions that would appear to lead to a presumption of harmonization of standards in the name of preventing trade distortions²⁰ -- which would seem a case of tunnel vision by free traders just as serious as that of environmentalists who want to harmonize in the name of environmentalism *über alles*.

How should we understand the urge to harmonize where harmonization would lead to economic inefficiency and is likely to harm the (relatively low-income) country with the lower standard? This section considers some of the possible reasons for the urge to harmonize. One set of dubious arguments arises because the rationale harmonization comes when people simply have other objectives in mind than economic efficiency or when the distinction between local and global public goods is overlooked. Another group of arguments rests on the failure of the assumptions of the classical model of trade and externalities or on distributional considerations.

B. Alternative Objectives

1. *Environmentalist objectives*

The most vocal arguments for imposing more stringent standards come from the environmental community. Some of the reasons are based on failures of the classical model that will be analyzed in the next section. In addition,

²⁰ The Sanitary and Phytosanitary Code and a revised Standards Code requires parties to base their national standards on the international standards established by organizations such as the Codex Alimentarius Commission. Countries may adopt higher levels of protection when such measures are the least restrictive to trade, have no extraterritorial implications, and are scientifically based. (On these points, see Zaelke, Orbuch, and Housman [1993].) Both because there seems to be a presumption in favor of harmonization and because it is not obvious that those standards that are "least restrictive to trade" are also ones that are most cost-beneficial, this new set of provisions raises serious issues for economic efficiency.

environmentalists may simply substitute their own preferences for those that are revealed in the market place — in effect, assuming a different set of implicit prices and in effect assuming that the price of environmental goods and services are raised relative to those of other goods and services.

It is difficult to make a air-tight argument against someone who believes he has the correct values. However, this approach is disturbing in a number of dimensions. First, when values are imposed on other countries, it has the smell of *value imperialism* in which the rich countries (or certain interest groups in rich countries) take the stance of philosophical and moral superiority over other countries. Second, the position is illiberal and difficult to universalize. Once we accept the possibility that a group's preferences will override both state and market, there is no obvious way to know whose preferences to empower. Why environmentalist preferences as opposed to religious, nationalist, separatist, Rawlsean, or Hayekian preferences?

2. *Protectionism*

A second example of attempts to override revealed political and economic preferences is seen when certain industries band together with environmental groups to argue for raising production costs by raising environmental standards. This would seem to be no more than old-fashioned protectionism and is subject to the standard critiques.²¹

C. Government failures

The most important set of objections to the economic argument against harmonization arises because of questions about the extent to which governments actually undertake efficient or even reasonable environmental policies. What if governments employ poorly designed policies? What if they have no environmental policies at all or, as in the case of many formerly planned economies, have stringent environmental policies but fail to enforce them? These questions raise the possibility that government failures lead to such inefficient policies that international actions needs to be taken to put pressure on countries or force them to adopt more stringent

²¹ See Bhagwati [1988] for a fine treatment of the theory and ideology of protectionism.

environmental standards. In other words, *are government failures a sufficient reason to enforce harmonization of environmental standards?*

Often governments may be well-meaning but incompetent. Their incompetence may arise for technical reasons, such as they do not know how to manage toxic wastes or to design and operate a nuclear power plant safely (as in Chernobyl). Or the administrative capacity of the government may be minimal in the sense that the government does not know how to operate a permitting or monitoring system. Additionally, governments may be too weak to impose their authority over firms and individuals; this syndrome would appear to be quite prevalent today in Russia and parts of Africa. For incompetent governments, the general remedy is to provide information and technical assistance rather than to deny the nation's ability to participate in international trade. In rare cases, often involving global public goods such as nuclear non-proliferation, the world would probably be better off with restrictions on commerce, but an affirmative case would have to be made for this policy.

Another second general class of government failures arises when governments do not properly represent the interest of their residents. A common complaint about governments is that they have short time horizons, either because of electoral competition in democratic systems or because of fear of being overthrown in authoritarian systems. If governments have short time horizons, this gets translated into too-high a discount rate on government investment decisions. Put differently, since future generations have no explicit say in the political process, there is no guarantee that they will be appropriately represented.²² Temporal myopia might be particularly worrisome for long-lived investments such as those involving forests, soils, and water systems.

The other extreme of government failure comes when governments are unresponsive rather than overresponsive, for example in venal and corrupt behavior in which government policies are addressed to the wealth of the governing rather than the welfare of the people.

For both cases of non-responsive government, the public-policy failures are

²² See Brown-Weiss [1990] for a discussion of this issue in the context of environmental law.

likely to spread far beyond environmental policy and include discrimination, violation of basic human rights, disregard of the public health and safety, or plunder. As has been shown too many times, it is difficult to construct sanctions on a country that will force it to lengthen its time horizon or to be responsive to its population.²³ Often sanctions create shortages and worsen environmental conditions. We can illustrate the issue of nonresponsive governments in Figure 5. Government failures will push the economy inside its *PPF*, as to point *N*. If external pressures are counterproductive, they may actually make things worse off, as for example if sanctions create shortages and push the economy from *N* to *S*. A more constructive policy would be to provide technical assistance, so that the country can move out toward point *A*.

D. Jurisdictional Competition (the "race to the bottom")

An interesting argument for harmonizing standards is that governments may compete with one another for jobs or industries by lowering environmental standards. There might then ensue a "race to the bottom" in which each country lowers its standards to keep its costs below those of other countries until standards (or their equivalent in emissions fees) are far below what countries would adopt in isolation. Thus writes Ralph Nader:

U.S. corporations long ago learned how to pit states against each other in "a race to the bottom"--to profit from the lower wages, pollution standards, and taxes....The trade agreements are crafted to enable corporations to play this game at the global level, to pit country against country in a race to see who can set the lower wage levels, the lowest environmental standards, the lowest consumer standards....Worst of all, the corporate-induced race to the bottom is a game that no country or community can win....The game of countries bidding against each other causes a downward spiral.²⁴

There are three different variants of this argument.

²³ See Hufbauer, Schott, and Elliott [1990].

²⁴ See Nader [1993], p. 6-8.

1. Small countries

The simplest case is of small countries, ones that are price takers in international markets. Such countries adopt a Nash strategy with respect to prices and other countries' environmental and trade policies. In this case, countries cannot affect their terms of trade and will simply set environmental policies in the classical way described above. For small countries, there is simply no race at all.

2. Large countries

For large countries, the case is somewhat more complicated. The argument here is really a variant of arguments about subsidies in international trade. There are three steps to the argument. First, countries may subsidize their domestic production in order to gain a competitive advantage; second, they choose environmental policies as the instrument to subsidize particular industries; and, third, once one country uses this vehicle, others will engage in a competitive environmental-subsidy race to the bottom. By enforcing common standards, the argument would conclude, the whole race is aborted.²⁵

This argument is in trouble at every step. The basic problem is that is that the first stage of the argument is wrong. Assuming countries are starting out in an internalized competitive equilibrium within the country, it is not generally beneficial to subsidize domestic industries or exports.

We can most easily see this in terms of the analysis of an "optimal tariff." Large countries can affect their terms of trade and have an incentive to adopt beggar-thy-neighbor policies, known as "optimal tariffs" on imported goods and services, in order to turn the terms of trade in their favor.

In the case at hand, countries are supposedly subsidizing domestic export industries. The corresponding beggar-thy-neighbor policy is the optimal *export tax* to capture the gains in the terms of trade that come from higher export prices. OPEC is probably the most successful case in point here, although some people believe

²⁵ This discussion is reminiscent of discussions of "unfair trade," in which countries adopt strategies to prevent other countries from subsidizing their exports. See Boltuck and Litan [1991].

that the Japanese have successfully created export taxes when they "submit" to voluntary export restraints.²⁶

Given that the "optimal" policy for exports is an export tax, it would not be sensible for governments of large countries to engage in export subsidization to compete internationally. While we cannot rule out the possibility that countries will race lemming-like to the bottom of the cliff by taking measures that are against their own interests, no country will rationally choose to enter the subsidy race. Indeed, if there is any economic incentive, it would be to *raise* standards as a way of putting on an implicit export tax. This would be a race to the top, although it is likely to be a pretty feeble and half-hearted race.

One might respond to this by saying that countries in fact *do* engage in competitive subsidization even though it is against their national interests. Countries might subsidize because of the successful lobbying of producer interest groups, or because there are monopoly profits or rents from their exports that they are in effect sharing in order to capture a market,²⁷ or simply because the economic analysis of subsidies is not understood. These three cases are all different, but in each case it seems unlikely that environmental standards would be a useful tool for competitive subsidization. They are simply too blunt an instrument to be an effective way to subsidize industries because the environmental costs differ so greatly among industries.²⁸

In addition, it is sometimes overlooked that there is a fundamental difference between the presumption about subsidies for goods and services and differential environmental standards. There are sound reasons for nations to agree that they should proscribe trade subsidies (as well as tariffs, quotas, etc.) because subsidies lead to economic inefficiencies and reduce potential world income. By contrast, differential environmental standards for local public goods or externalities are

²⁶ Many of the issues covered here are discussed in Siebert [1991], especially the introduction and the essay by Siebert.

²⁷ See Krugman [1986].

²⁸ The differences in the cost of pollution control per dollar of output are provided in Jorgenson and Wilcoxon [1990].

presumptively efficient, so to the extent that relative costs differ on these grounds, this is a reflection of differential comparative advantage rather than *deviations* from comparative advantage that result from trade subsidies or tariffs.

3. Policy Discrimination

A final issue arises when towns, states, or countries use environmental policies *in a discriminatory way* to attract industries, companies, or jobs to their location. A discriminatory policy is one in which the policies are applied in a more favorable fashion for one group than for the general economy.²⁹

To what extent is it efficient for countries to use discriminatory environmental policy as a tool of locational competition? This is an extension of the question of the efficiency of price discrimination to include other attributes. Although price discrimination sounds offensive to many people, its effects on efficiency are ambiguous. The case of "first-degree" price discrimination arises when a seller discriminates perfectly among different customers, and this situation is known to be efficient. Other examples of discrimination may improve or harm efficiency depending upon the case at hand. In sum, there is no general presumption that policy discrimination is inefficient.³⁰

From a broader perspective, the hypothesis about the "race to the bottom" would seem to be inconsistent with the incentives of the international-trade game. If we step back from the intense debates about harmonization, we might wonder whether there should not be a strong presumption in favor of locational competition among jurisdictions. In mobile societies we are likely to see "Tiebout competition," which makes governments feel competitive pressures when people vote with their feet by moving to more attractive locations.³¹ Locational competition is just another dimension of Tiebout competition. While there are counterproductive cases of non-

²⁹ In the language of international-trade law, these would be "specific" subsidies.

³⁰ A useful summary is contained in Philips [1987].

³¹ Tiebout [1956] observed that when local governments provide a variety of public goods, people may be allowed to choose their preferred public goods through mobility and differential provision of public goods across different jurisdictions.

market competition (such as warfare), history is full of examples -- from the Golden Age of Greece, Italian cities, the Hanseatic League, to East-West economic rivalry -- where the competition among city-states or nations has led to striking innovations or to the demise of oligarchies. It is not hard to imagine the damage to human welfare if binding international standards had frozen in the Oldowan chopper, the Greek social structure, pre-Palladian buildings, Louis XIV's tax structures, 18th century sailing ships, 19th century lighting fixtures, or the Soviet planning model.

E. Implicit global public goods

We showed above that while harmonization was inappropriate and inefficient in the case of local public goods or local environmental problems, harmonization is indeed not only appropriate but necessary for the efficient provision of global public goods. This suggests that some of the arguments for harmonizing standards arise because environmental problems have, or are perceived to have, some element of transnational spillover. These we call *implicit global public goods*.

One example of an implicit global public good arises when people in country *A* have strong feelings about environmental conditions in country *B*. For example, a biologist might care greatly about the plenitude of species in the Brazilian rain forest, or a child-welfare advocate might find conditions in Chinese factories abysmal, or an environmentalist might believe that netting dolphins in Mexico's territorial waters will unnecessarily deplete the breeding stock of those delightful animals.

These cases are genuinely different from the value imperialism discussed above, for in these cases there is a genuine element of global public good because people care about environmental (or other) conditions in areas under someone else's (or in some cases, no one's) jurisdiction. The difficulty is that there is no easy way for a citizen of country *A* to affect policies in country *B* (or more generally for agent *A* to change the decisions of agent *B* on affair *C* when *B* has complete property rights in and control over *C*).

A concept that has recently emerged in international law to reflect the possibility of such global concerns is what is called the "common concern of

mankind."³² This concept, which to do has no formal legal force, was invoked by the U. N. General Assembly in 1988 to establish an international convention to prevent harmful climate change. The "common concern" concept would seem to be limited to essential³³ global public goods, however, for the language states that "climate change is a common concern of mankind since climate is an essential condition which sustains life on earth."³⁴ The concept does pose serious difficulties because it is hard to know when affair C is a legitimate "common concern of mankind" rather than simply someone's strongly held values or opinions.

The case of common concern of mankind or strong feelings is a special case of the more general problem that arises under *non-egotistical preferences*. Egotistical preferences are the standard approach in economics of assuming that each agent's preferences are a function only of his or her own consumption.³⁵ When preferences include other people's welfare (either positively as altruism or negatively as spite), or if other species welfare is included (as in the "biospheric view"³⁶) then

³²This is an extension of "the common heritage of mankind," which appears in the Law of the Sea treaty. The treaty states that the deep seabeds are the common heritage of mankind, may not be appropriated by any state, and are open to use by all states and their nationals for peaceful purposes. Ironically, this would appear to declare them open for over-exploitation as common-property resources. The "common heritage" concept has been applied to a number of international public goods, including whales and other species, Antarctica, cultural properties, geostationary orbits, outer space, and the moon.

³³ "Essential" in this context would mean that the elasticity of substitution between this input and other inputs is less than unity so that no production is possible without a minimal input of the essential input.

³⁴ See UN [1988].

³⁵ For a critique of egotistic preferences and a discussion of non-egotistical preferences, see Sen [1987].

³⁶ Virtually all legal and economic analysis is grounded in the presumption that values are based on human preferences and rights. The anthropocentric view is challenged by what is called "deep ecology" or the "biospheric view." This is expressed in by Arne Naess and George Sessions: "[A]ll organisms and entities in the ecosphere, as parts of the interrelated whole, are equal in intrinsic worth." (Devall and Sessions [1985], p. 67) This is interpreted in the economic framework as putting utilities of non-human entities (dolphin pain, the soul of the coral reefs, ...) into a generalized Bergson-Samuelson-Devall-Sessions biospheric social welfare function.

most of the classical economic propositions break down. The implications of altruistic preferences for trade and the environment have not, however, been worked out.

F. Equity and environmental justice

A final issue that has recently surfaced is "environmental justice." This idea, which arises both within and among nations, holds that poor people tend to experience environmental problems most seriously and that elemental justice requires that steps be taken to correct the existing distribution of environmental services. Within the United States, it is often held that the poor and minority groups are systematically discriminated against in the siting, regulation, and abatement of waste facilities, toxic dumps, and harmful industrial siting. For example, Bullard argued that "black Houston [is the] dumping grounds for the city's household garbage."³⁷ In response to this problem, President Clinton issued an executive order in 1994 that required federal agencies to demonstrate that their programs do not unfairly inflict harm on the poor or minorities.

While this idea has some emotional appeal, it makes little sense in an international framework. It is surely true that poor- and middle-income countries suffer some of the most grievous environmental problems. But it is not clear that either harmonization of environmental standards or requiring improvements of the environment are in those countries' interests, or in the interests of the poorest groups of those countries. Environmental conditions are only one part of a larger syndrome of poverty, ill health, and poor living conditions. It is likely that health measures in low-income countries are as important or more important for health status as are environmental improvements. Either these countries are going to be forced to *redistribute resources* from non-environmental goods and services to environmental improvement, or rich countries may decide to *make resource transfers* to poor countries. The first case we have discussed extensively above and shown to be inconsistent with the general presumptions of international trade theory. With respect to the second, the issue is whether incremental resources are best applied to environmental sectors rather than to education, health, and other pressing human needs.

³⁷ See Bullard [1983].

G. *Second-Best Considerations*

Finally, does not the general theory of the second-best apply here because of market and government failures? Few think that the standard assumptions of international trade theory among countries with internalized competitive equilibria hold exactly. Having said this, it does not follow that any sort of intervention would improve the outcome. Correcting the defects of the market and government might allow Pareto improvements; adding additional inefficiencies on top of those that already exist cannot guarantee improved economic welfare and is surely not a recommended approach in the absence of some presumptive demonstration that it will.

V. *Conclusions*

This essay has addressed the question of whether locational competition should be encouraged or discouraged with special attention to the question of harmonization of environmental standards. The conclusions are four.

First, for public goods or environmental problems that are pure public goods, economic efficiency *requires harmonization* of policies; more precisely, efficient policies should equate the marginal cost of emissions across all regions for the case of global externalities. The appropriate harmonization will generally not be quantitative standards but emissions fees or the prices of auctionable permits (such as permits to produce ozone-depleting chemicals or emit carbon dioxide). Forging international agreements that meet the strict test of efficiency for global public goods or externalities is obviously a difficult task, but including all the major actors is necessary for efficient outcomes.

Second, for local public goods or externalities, there is a strong presumptive case *against harmonization*. Local public goods or externalities are ones where the impacts by definition do not cross borders so that all the costs and benefits of controls are captured within the boundaries of a country. Because they are local, they represent non-traded goods and services. Standard international-trade theory implies that an efficient allocation would lead to differing prices in different regions

depending upon tastes and comparative production advantages. Starting from an internalized competitive equilibrium, attempts to harmonize environmental standards or emissions fees of local public goods would lead to inefficiencies and to the deterioration of potential economic welfare.

Third, there are many qualifications to the two basic points just summarized depending upon whether individual countries can and do efficiently regulate their local public goods and externalities, on the objectives of policy, on the presence or absence of government failures, and on the extent to which goods contain a mixture of global and local elements. While we cannot make unqualified statements about the impact on efficiency of harmonization or lack of harmonization when the strict assumptions of classical trade theory do not hold, the presumption must be that directly attacking the other deficiencies (such as government incompetence or great income inequality) would be a more efficient way of attaining social objectives.³⁸

Fourth, concerns has been raised that countries may engage in a competitive "race to the bottom" -- lowering their environmental standards -- as a way of improving their international competitiveness. This syndrome is a specific example of countries using non-price instruments to pursue their optimal tariffs or subsidies and is not limited to environmental questions. Analysis shows that it is not generally in the interests of countries to subsidize exports or to lower standards, which are beggar-thy-self policies. Moreover, given the lack of correspondence between environmental policies and implicit subsidies, it would be difficult to construct a targeted set of such subsidies. If anything, the economic incentive is for a race to the top rather than the bottom.

In the end, whatever may be the putative benefits of restrictions on locational competition, the costs of restrictions on locational competition seem more worrisome. Locational competition is one of the few ways that localized market power can be threatened, whether that power resides in labor unions, public utilities, the markets for non-traded goods and services, or in the power of narrow interest groups. Locational competition can spur new ideas and ways of thinking and lead to the efficiencies that are generally associated with price or quality competition. Rather than lead countries to lower their standards, locational competition seems

³⁸ This point has been shown most generally in Bhagwati and Ramaswami [1963].

more likely to prod or stimulate them to think about better ways of mitigating environmental policies in cost-effective ways. Surely any policy that has a chilling effect on locational competition would seem dubious on its face.

References

- Bhagwati, Jagdish [1988]. *Protectionism*, MIT Press, Cambridge, Mass.
- Bhagwati, Jagdish [1993]. "Trade and the Environment: The False Conflict?" in Zaelke, Durwood, Paul Orbuch, and Robert Housman [1993]. *Trade and the Environment: Law, Economics, and Policy*, Island Press, Washington, D. C., pp. 159-190.
- Bhagwati, Jagdish and V. K. Ramaswami [1963]. "Domestic Distortions, Tariffs, and the Theory of the Optimal Subsidy," *Journal of Political Economy*, vol. 71, February, pp. 44-50.
- Bhagwati, Jagdish and T. N. Srinivasan [1993]. "Trade and the Environment: Does Environmental Diversity Detract from the Case for Free Trade?" paper prepared for the Ford Foundation project on Fair Trade and Harmonization, July.
- Boltuck, Richard and Robert E. Litan, eds. [1991.] *Down in the Dumps: Administration of Unfair Trade Laws*, Brookings Institution, Washington, D. C.
- Brown-Weiss, Edith [1990]. "Our Rights and Obligations to Future Generations for the Environment," *American Journal of International Law*, vol. 84, p. 190.
- Bullard, Robert D. [1983]. "Solid Waste and the Black Houston Community," *Sociological Inquiry*, vol 53, Spring, pp. 273-288.
- Charnovitz, Steve [1993]. "Environmental Harmonization and Trade Policy," in Zaelke, Durwood, Paul Orbuch, and Robert Housman, eds., *Trade and the Environment: Law, Economics, and Policy*, Island Press, Washington, D. C., 1993, pp. 267-286.
- Cropper, Maureen and Wallace Oates [1992]. "Environmental Economics: A Survey," *Journal of Economic Literature*, vol. 20, June, pp. 675-740.
- Devall, Bill and George Sessions. [1985]. *Deep Ecology: Living As If Nature Mattered*, Salt Lake City, Gibbs Smith.

Economist [1992]. "Let Them Eat Pollution," February 8, p. 66.

Financial Times [1992]. "Trade Row Looms over U.S.'s Dolphin-friendly Tuna Policy," Jan. 30, p. 22.

Hufbauer, Gary Clyde, Jeffrey J. Schott, and Kimberly Ann Elliott [1990]. *Economic sanctions reconsidered: History and current policy*, Second edition, Washington, D.C.: Institute for International Economics, 1990.

Housman, Robert F. and Durwood J. Zaelke, "Trade and the Environment: Making Trade and Environmental Policies Mutually Reinforcing," *Environmental Law*, vol. 23, Winter, p. 545.

Jackson, John [1992]. "World Trade Rules and Environmental Policies: Convergence or Conflict?" *Washington and Lee Law Review*, vol 49, Fall, pp. 1241-1242.

Jorgenson, Dale W. and Peter J. Wilcoxon [1990]. "Environmental Regulation and U.S. Economic Growth," *Rand Journal of Economics*, vol. 21, pp. 314-340.

Kaufmann, Robert K., Peter Pauly, and Julie Sweitzer [1993]. "The Effects of NAFTA on the Environment," *Energy Journal*, 14(3), 1993, pages 217-40.

Krugman, Paul R., ed. [1986]. *Strategic Trade Policy and the New International Economics*, MIT Press, Cambridge, Mass.

Mendelsohn, Robert O. [1978]. *Toward Efficient Regulation of Air Pollution from Coal-Fired Power Plants*, Ph. D. dissertation, Yale University, New Haven, Ct.

Nader, Ralph [1993]. "Introduction: Free Trade and the Decline of Democracy," in Ralph Nader et al., *The Case Against Free Trade: GATT, NAFTA, and the Globalization of Corporate Power*, Earth Island Press, San Francisco, Calif., pp. 1-12.

Phlips, Louis [1987]. "Price Discrimination," in John Eatwell, Murray Milgate, and Peter Newman, *The New Palgrave: A Dictionary of Economics*, The MacMillan

Press Ltd, London, pp. 952-954.

Robertson, David [1992]. "Trade and the Environment Harmonization and Technical Standards," in Patrick Low, ed., *International Trade and the Environment*, 309.

Sen, Amartya K. [1987]. *On Ethics and Economics*, Blackwell, Oxford, U. K.

Siebert, Horst [1991]. *Environmental Scarcity: The International Dimension*, J. C. B. Mohr, Tübingen, Germany.

Stewart, Richard B. [1992]. "International Trade and Environment: Lessons from the Federal Experience," *Washington and Lee Law Review*, vol 49, Fall, pp. 1329-1358.

Tiebout, Charles [1956]. "A Pure Theory of Local Expenditures," *Journal of Political Economy*, vol.64, October, pp. 416-424.

UN [1988]. United Nations General Assembly Resolution 43/53, December 6.

Weitzman, Martin [1974]. "Prices vs. Quantities," *Review of Economic Studies*, vol. 41, October, pp. 477-491.

Whalley, John [1991]. "The Interface between Environmental and Trade Policies," *Economic Journal*, 101(405), March 1991, pages 180-89.

World Bank [1993]. *World Development Report: Health*, World Bank, Washington, D. C.

Zaelke, Durwood, Paul Orbuch, and Robert Housman [1993]. *Trade and the Environment: Law, Economics, and Policy*, Island Press, Washington, D. C.

Figure 1

Marginal Costs and Benefits of
Emissions Reductions

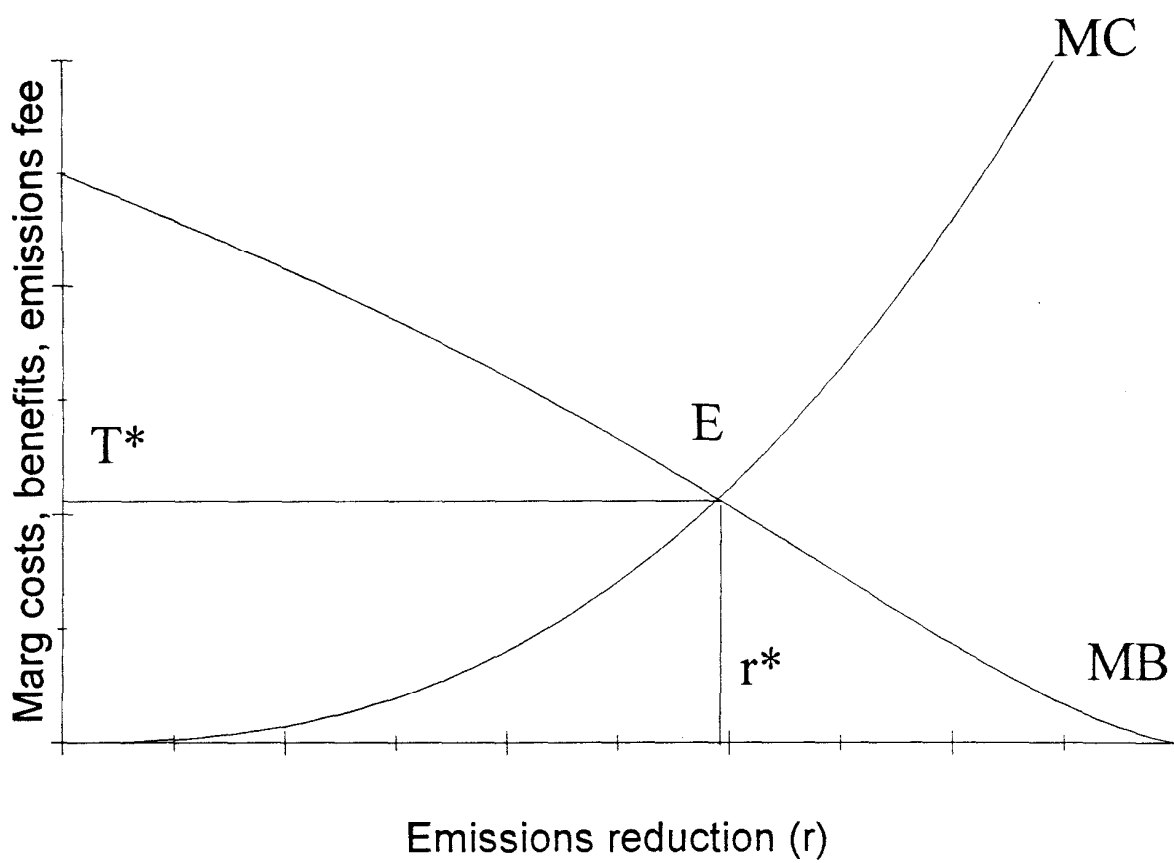
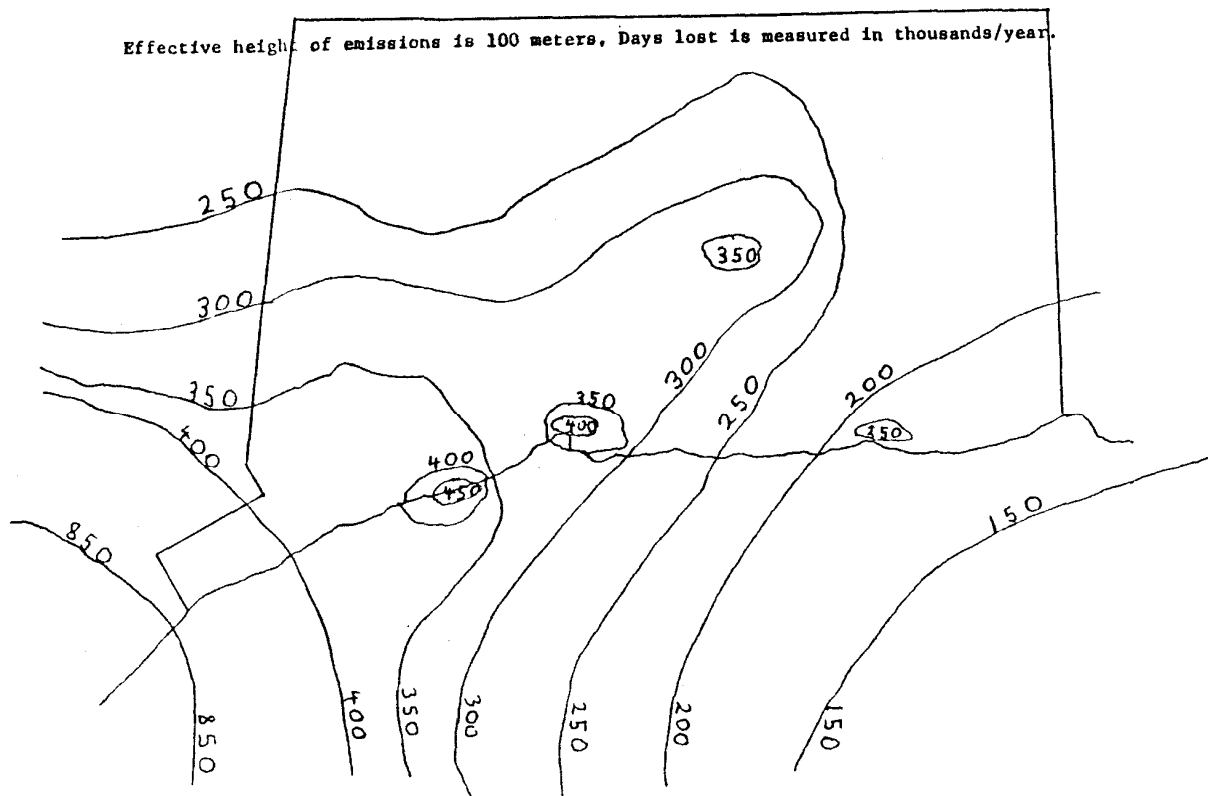


Figure 2
Health Days Lost from the Uncontrolled Emission
of a Coal-Fired Power Plant in Different Locations in Connecticut



Source: Mendelsohn [1978].

Figure 3

Policy for Global Externality

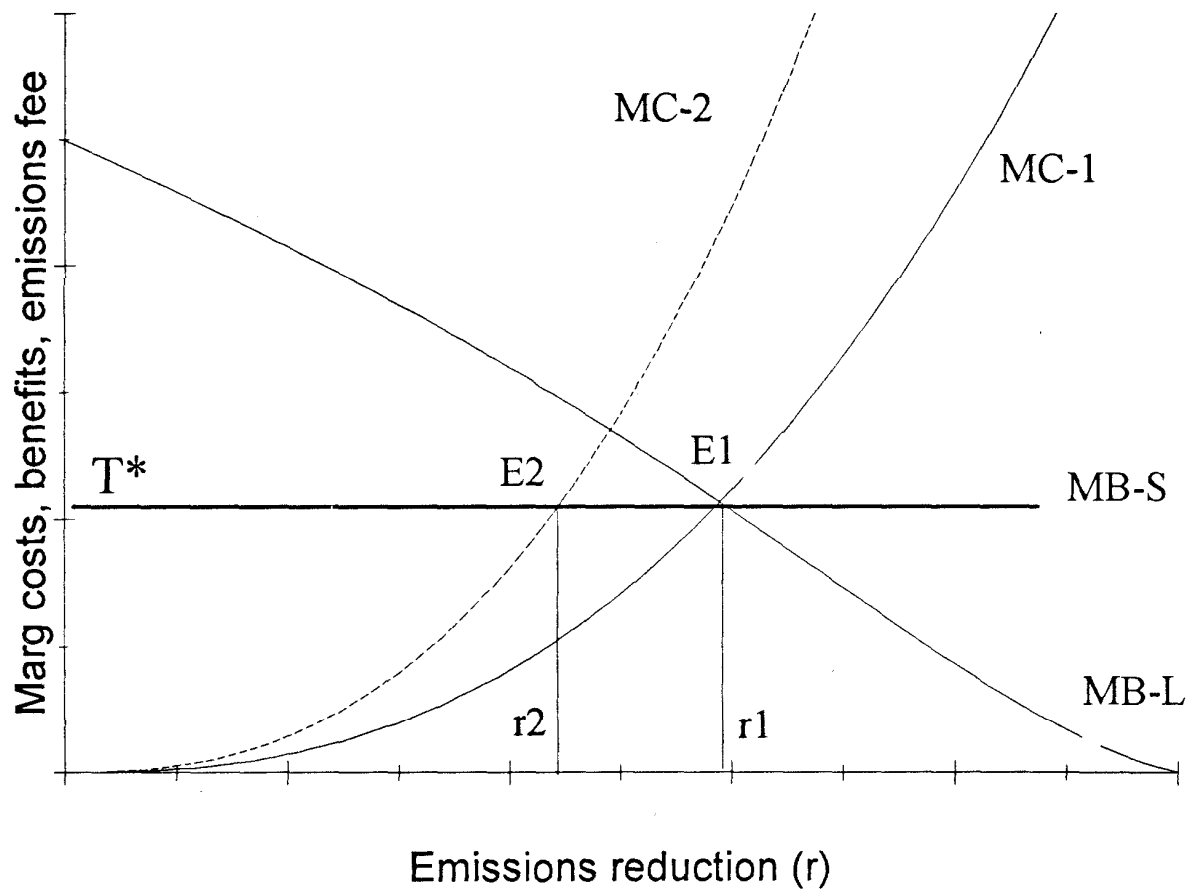


Figure 4

Policy for Local Externality

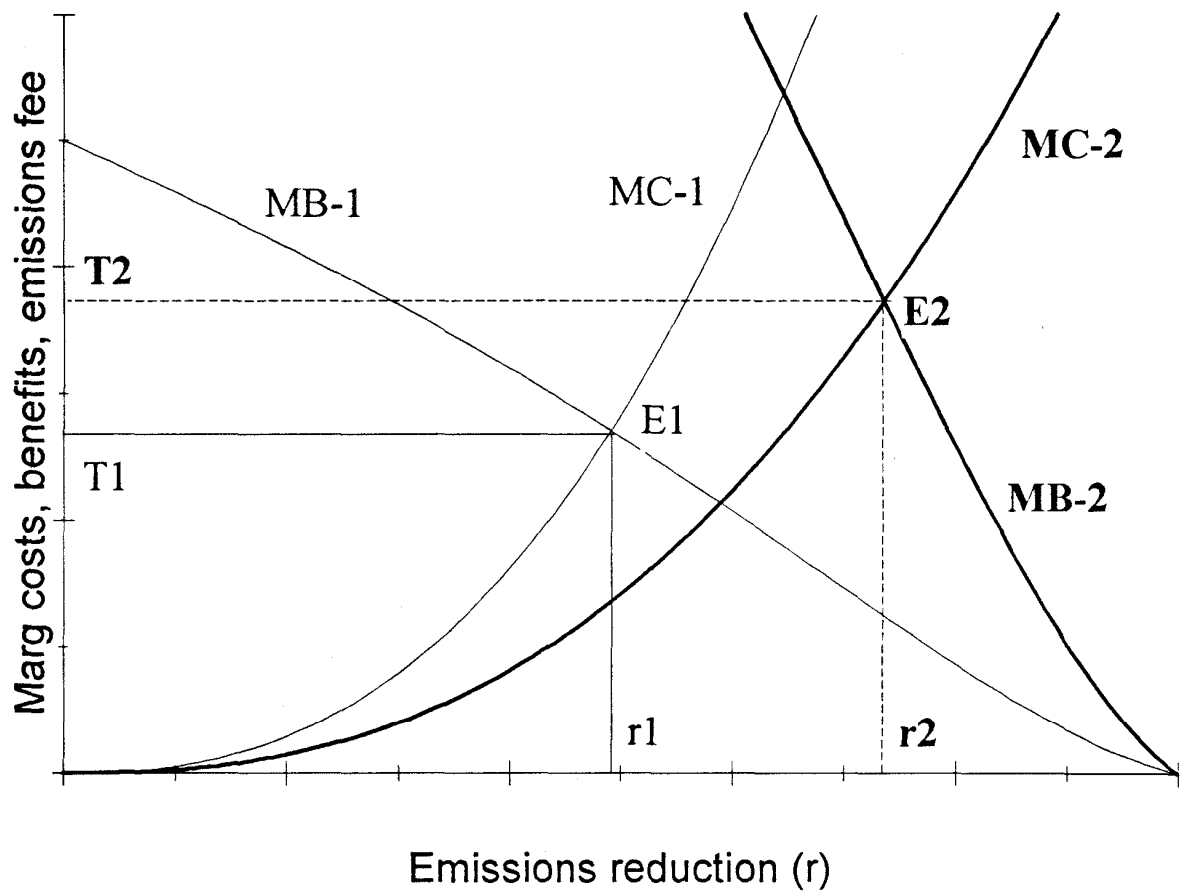


Figure 5

Life Expectancy and Income

